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Alternative futures: Have EPA projects made a difference?

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What are alternative futures assessments?

A process by which to evaluate potential changes to land and water use, where
- Two or more alternative landscape-scale scenarios are considered,
- The alternatives are represented spatially in maps and models,
- One or more measurements of important social and environmental goals are made,
- The alternatives are compared using the measurements.

Development of scenarios

Defining scenario assumptions with
- Stakeholder groups: more conventional and plausible scenarios,
- Technical experts: more applied science and engineering in scenarios,
- Academics: more innovation and variability in scenarios;

Synthesizing scenarios from multiple viewpoints:
- Choosing types of scenarios by
  - Intensity of human development, ranging from less to more, or
  - Special features or themes, e.g., growth policies, restoration potential, transportation;
- Characterizing human population change by
  - Assuming constant growth in all scenarios, but varying spatial density, or
  - Varying growth or decline across scenarios.

Lessons learned:

Projects are more likely to influence decisions and actions if they
- Have continuing EPA involvement;
- Are smaller in geographical area;
- Are located in a single political jurisdiction;
- Have substantial local concern about issues.

Projects can be conducted by private sector in conjunction with EPA and others.

Example Projects:

1. Monroe County (1993-1995)

Location and size of project area:

Monroe County in eastern Pennsylvania Poconos region, 1580 sq km.

Investigators:
Carl Steinitz, Harvard University, and students; Susan McDowell, US EPA; Charles Smith, Cornell University; Milo Richmond, Cornell University; Denis White, Oregon State University; Priscilla Minotti, Oregon State University; Mary Barczak, Oregon State University; Jean Sifneos, Oregon State University; Kathryn Freemark, Environment Canada; Mary Santelmann, Oregon State University; Eric Preston, US EPA; Ross Kiester, USDA Forest Service

Environmental stresses and issues:
Recreational development and associated rural residential (second home) housing

Sponsors and stakeholders:
US EPA Region 3, ORD/NHEERL/WED; The Nature Conservancy; Monroe County Planning Staff; Monroe County Conservation District

Types of future scenarios: [Time Frame 1990-2020]
1. Build-Out: all land zoned for development is developed
2. Plan-Trend: current Comprehensive Plan is fully implemented
3. Township: development controlled by 20 townships in county
4. Spine: development concentrated along railroad through center of county
5. Southern: development concentrated in southern (agricultural) part of county
6. Park: all existing undeveloped land is placed in conservation reserves

Evaluation criteria:
Surface water quality; Water recharge areas; Agricultural soils; Biodiversity; Bear habitat; Special natural areas; Scenic elements; View quality; Human population capability; Cost of public action; Enabling private decision-making; Enabling township decision-making; Enabling county decision-making

A separate study evaluated change in habitat for amphibians, reptiles, birds, and mammals

Results:
On a five point scale (1 = most negative, 2 = negative, 3 = neutral, 4 = positive, 5 = most positive), the sums of the scores for each scenario were:
1. Build-Out: 21
2. Plan-Trend: 24
3. Township: 41
4. Spine: 39
5. Southern: 42
6. Park: 48

All groups of vertebrate species showed average declines of about 35% to 50% of habitat in the Build-Out and Plan-Trend scenarios relative to the current conditions. For Township and Spine scenarios the declines were about 5% to 20%. For Southern scenario the declines were 3% to 12%, and for Park the declines were negligible.

Consequences:
Stimulated development of a new County Comprehensive Plan. The County passed a $25 million Open Space Referendum in 1998. Supported hiring of additional County planning staff.

References:
Steinitz C, et al. (students in Monroe County studio). 1994. Alternative futures for Monroe County, Pennsylvania. Privately published at Harvard University.

White D, Minotti P, Barczak M, Sifneos J, Freemark K, Santelmann M, Steinitz C, Kiester R, Preston E. 1997. Assessing risks to biodiversity from future landscape change. Conservation Biology 11(2):349-360.

Steinitz C, McDowell S. 2001. Alternative futures for Monroe County, Pennsylvania: a case study in applying ecological principles. Applying ecological principles to land management. Dale VH, Haeuber RA, editors. Springer, New York. pp. 165-193.

US EPA, Region 3. Green Communities: Monroe County, PA. http://www.epa.gov/greenkit/monroe.htm (last accessed 15 April 2003).

2. Camp Pendleton (1994-1996)

Location and size of project area:
A rectangular area 80 by 134 km, or 10,720 sq km, surrounding Camp Pendleton Marine Corp Base including portions of Orange, Riverside, and San Diego Counties in southern California.

Investigators:
Carl Steinitz, Harvard University; Michael Binford, Harvard University; Paul Cote, Harvard University; Tom Edwards, USGS Biological Resources Division; Steve Ervin, Harvard University; Richard Forman, Harvard University; Craig Johnson, Utah State University; Ross Kiester, USDA Forest Service; David Mouat, US EPA; Doug Olson, Harvard University; Allan Shearer, Harvard University; Richard Toth, Utah State University; Robin Wills, The Nature Conservancy

Environmental stresses and issues:
Urbanization leading to impacts on wildlife, hydrology, and wildfire potential

Sponsors and stakeholders:
US Department of Defense, US EPA Region 9, ORD/NHEERL/WED; Marine Corps Base Camp Pendleton, The Nature Conservancy

Types of future scenarios: [Time Frame 1990-2010]
1. Plans Build-Out: development allowed under current jurisdiction plans
2. Spread: low density and clustered rural residential development
3. Spread with Conservation 2010: Spread but with conservation measures

4. Private Conservation: low density development with large-lot private conservation
5. Multi-Centers: cluster development and new communities
6. New City: most development in one city in Riverside County

Additional studies were done at restoration, subdivision, and third order watershed scales.

Evaluation criteria:
Visual preference, Agricultural productive soils, Runoff curve number, Flood hydrograph, Water discharge, Fire risk, Landscape ecological pattern, Single species potential, Species richness, Species with 500+ home ranges

Results:
On a five point scale (1=worst, 5=best) for each evaluation criterion, the sums of the scores for each scenario were:
1. Plans Build-Out: 18
2. Spread: 14
3. Spread with Conservation 2010: 29
4. Private Conservation: 49
5. Multi-Centers: 31
6. New City: 32

Consequences:
Marine Corps Base Camp Pendleton and other interested parties used evaluation results in considering policies for land use planning in the region.

References:
Steinitz C, et al. (all investigators listed above). 1996. Biodiversity and landscape planning: alternative futures for the region of Camp Pendleton, California. Privately published at Harvard University.

http://www.gsd.harvard.edu/studios/brc/brc.html (last accessed 9 April 2003)

3. Muddy Creek (1995-1997)

Location and size of project area:
Watershed of 320 sq km in the southwestern part of the Willamette River Basin, in western Oregon.

Investigators:
David Hulse, University of Oregon; Lisa Goorjian, University of Oregon; David Richey, University of Oregon; Michael Flaxman, University of Oregon; Cheryl Hummon, Oregon State University; Denis White, Oregon State University, US EPA; Kathryn Freemark, Environment Canada; Joseph Eilers, E&S Environmental Chemistry; Joseph Bernert, E&S Environmental Chemistry; Kellie Vache, E&S Environmental Chemistry; Jolie Kaytes, University of Oregon; David Diethelm, University of Oregon; Steven Radosevich, Oregon State University

Environmental stresses and issues:
Gradual urbanization and intensification of forestry and agriculture

Sponsors and stakeholders:
US EPA Region 10, ORD/NHEERL/WED; agriculture and forestry experts and private citizens of the watershed

Types of future scenarios: [Time Frame 1990-2025]
1. High Development
2. Moderate Development
3. Plan Trend
4. Moderate Conservation
5. High Conservation

Scenarios varied systematically from high human population growth to low, higher conversion of pasture to hybrid poplar to low, no hedgerows or windbreaks to more, shorter forest harvest rotations to longer, and smaller and fewer riparian buffers to more and larger. In addition there was an historical scenario constructed from vegetation surveys coincident with the original land surveys in the 19th Century.

Evaluation criteria:
Surface runoff, Total suspended solids, Total phosphorus, Change in habitat for amphibians, reptiles, birds, and mammals, Change in total number of species

Results:
Total suspended solids and total phosphorus were highest in High Development and lowest in the historical scenario with monotonic trends in between. Surface Runoff had the same trend but with much less change from scenario to scenario. Amphibians, birds, and mammals lost the most habitat in High Development and gained the most in either High Conservation or in the historical scenario. Reptiles showed the opposite trend because, in part, they benefited from the more open forest landscape (younger aged forests) in the more developed scenarios.

Consequences:
Used by county planners in investigating parcel size regulations and groundwater supplies. Used by state wildlife planners in promoting conservation easements. Stimulated development of several other projects (see Willamette River Basin, Iowa Watersheds) in the US and Canada.

References:
Hulse D, et al. (investigators listed above). 1997. Possible futures for the Muddy Creek Watershed, Benton County, Oregon. Privately published at University of Oregon.

Hulse D, Eilers D, Freemark K, Hummon C, White D. 2000. Planning alternative future landscapes in Oregon: evaluating effects on water quality and biodiversity. Landscape Journal 19(2):1-19.

Freemark K, Hummon C, White D, Hulse D. 1996. Modeling risks to biodiversity in past, present, and future landscapes. Technical Report No. 268, Canadian Wildlife Service, Headquarters, Environment Canada, Ottawa K1A 0H3. 60 pp.

4. Willamette River Basin (1997-2001)

Location and size of project area:
Large river basin, about 30,000 sq km, in western Oregon extending from coastal mountains to Cascade mountains and including a large agricultural and populated valley

Investigators:
David Hulse, University of Oregon; Stan Gregory, Oregon State University; Joan Baker, US EPA; plus many other investigators at the three institutions and related organizations

Environmental stresses and issues:
Urbanization, intensification of forestry and agriculture, regulated river flows

Sponsors and stakeholders:
US EPA Region 10, ORD/NHEERL/WED; Willamette Valley Livability Forum and Willamette Restoration Initiative (sponsored by Governor of Oregon)

Types of future scenarios: [Time Frame 1990-2050]
1. Plan Trend: current policies and practices extrapolated
2. Development: land use regulations relaxed in favor of development
3. Conservation: land and water allocation to conservation increased

In addition there was an historical scenario constructed from vegetation surveys coincident with the original land surveys in the 19th Century.

Evaluation criteria:
Population density in urban growth boundaries; Urbanized area; Rural developed area; Prime farmland; Water availability for urban, industrial, and agricultural water uses; Water consumed and changes in stream flow; Area in conifer forest > 80 years; % of riparian area in natural vegetation; Habitat for amphibians, birds, mammals, reptiles; Population abundance for 17 birds and mammals; Cutthroat trout habitat; Fish community index in lowland streams; Fish species richness in main river; Mayflies, stoneflies, and caddisflies species richness in lowland streams

Results:
Population density in urban growth boundaries increased almost 100% in Plan Trend and Conservation compared to current conditions, but only about 55% in Development. Urbanized area and rural developed area increased in all scenarios but most in Development. Prime farmland decreased in all scenarios but most in Development. Water consumption increased 40% to 60% in all scenarios relative to current conditions, but least in Conservation. Older conifer forest and riparian forest increased in Conservation but

decreased in the other two scenarios. All fish, wildlife, and insect indicators increased in Conservation but decreased in the other two scenarios. All biological indicators were much higher in the historical scenario than in current conditions; all except Cutthroat habitat were at least 40% higher than current conditions.

Consequences:
Governor appointed planning groups (listed above) used project analyses and results in public meetings, conferences, and publications. The project's conservation and restoration opportunities map used in Willamette Restoration Initiative's salmon recovery strategy. Other futuring activities by state agencies and non-governmental organizations also used project analyses. Debates in state agencies and other organizations on state-wide land use policy have been informed by project analyses.

References:
Hulse D, Gregory S, Baker J, editors. 2002. Willamette River Basin Planning Atlas. Oregon State University Press, Corvallis. 178 pp.

Baker J, Hulse D, Gregory S, White D, Van Sickle J, Berger P, Dole D, Schumaker N. Accepted. Alternative futures for the Willamette River Basin, Oregon. The first of six papers on the project in an invited feature in Ecological Applications.

5. Iowa Watersheds (1997-2000)

Location and size of project area:
Walnut Creek watershed in Story and Boone Counties, and Buck Creek watershed in Poweshiek County, Iowa, having 51.3 and 87.9 sq km, respectively.

Investigators:
Mary Santelmann, Oregon State University; Kathryn Freemark, Environment Canada; Joan Nassauer, University of Michigan; Denis White, US EPA; Joe Eilers, JC Headwaters Consulting; Kellie Vache, Oregon State University; Brent Danielson, Iowa State University; Rob Corry, University of Michigan; Mark Clark, Iowa State University; Steven Polasky, University of Minnesota; Richard Cruse, Iowa State University; Jean Sifneos, Oregon State University; Heather Rustigian, Oregon State University; Colette Coiner, Oregon State University; Diane Debinski, Iowa State University

Environmental stresses and issues:
Intensification of agriculture

Sponsors and stakeholders:
US EPA ORD/NCER STAR Program; USDA NRCS; Iowa Geological Survey; farmers from Story and Poweshiek Counties

Types of future scenarios: [Time Frame 1990-2025]
1. Production: profitable agriculture of grains and confinement livestock feeding
2. Water Quality: best management practices to maintain and improve water quality

3. Biodiversity: set-aside reserves and cropping strategies to enhance native biodiversity

Evaluation criteria:
Stream discharge; Sediment export; Nitrate-nitrogen export; Farm income; Farmer preference; Plant habitat; Butterfly habitat; Non-fish vertebrate habitat; Population viability of 50 mammals; Population viability of 4 amphibians

Results:
Water quality indicators improved over current conditions by 50% or more in Scenarios 2 and 3 in Walnut Creek and by 30% or more in Buck Creek. Improvements were much lower in Scenario 1 for discharge and sediment, and nitrate-nitrogen export became worse. Farm income was slightly higher than currently in Scenario 1 in Walnut Creek and 50% higher in Buck Creek. Farm income was higher in Buck Creek in Scenario 2 than in Scenario 1. Farm income decreased in both watersheds in Scenario 3. Farmers preferred Scenario 3 over Scenario 2, and both of those over current conditions. Scenario 1 was preferred less than current conditions. All biodiversity indicators improved in Scenarios 2 and 3 over current conditions in both watersheds except for butterflies in Scenario 2 and amphibian viability in Scenario 3 in Buck Creek. In Walnut Creek, several indicators improved by more than 100%. All biodiversity indicators declined in Scenario 1.

Consequences:
Stimulated development of other alternative futures project (see Blackberry Creek) in the US and Canada, as well as species recovery planning under the Canadian counterpart of ESA.

References:
Santelmann M, Freemark K, White D, Nassauer J, Clark M, Danielson B, Eilers J, Cruse R, Galatowitsch S, Polasky S, Wu J. 2001. Applying ecological principles to land-use decision-making in agricultural watersheds. Applying ecological principles to land management. Dale VH, Haeuber R, editors. Springer, New York. pp. 226-252.

Nassauer J, Corry R, Cruse R. 2002. Alternative future landscape scenarios: a means to consider agricultural policy. Journal of Soil and Water Conservation 57(2):2044-2053.

6. Blackberry Creek (2001-2003)

Location and size of project area:
Watershed of 190 sq km primarily in Kane County, Illinois, west of the Chicago metropolitan area

Investigators:
Tom Price and Charles Hassrick, Conservation Design Forum; Ksenia Rudensiuk, The Conservation Foundation; Ken Anderson, Kane County; William White and Marvin Hubbell, Illinois Department of Natural Resources, Sue Elston and Richard Sumner, US EPA

Environmental stresses and issues:

Urbanization impacts on wetlands and stream corridors, aquatic habitat, and stormwater management

Sponsors and stakeholders:
US EPA Region 5, OWOW; Kane County; Illinois Department of Natural Resources; Illinois Water Survey; Northern Illinois Planning Commission; The Conservation Foundation; Blackberry Creek Resource Planning Committee; municipalities in Kane County and Fox River Basin.

Types of future scenarios: [Time Frame 1990-2020]
Multi-parcel "templates" represent a typical land use cover type, such as commercial, residential, stream corridor or wetland designations. Sets of templates represent "conventional" or "conservation-based" design assumptions. Scenarios reflect an allocation of conventional templates or the conservation templates across the watershed. The current Kane County 2020 comprehensive land use plan is used as a framework for the allocation of templates. The conservation scenario includes additional connectivity between natural resource features.

Evaluation criteria:
Properties of hydrographs; fish or aquatic insect community indices by correlation with hydrographs

Results:
Preliminary project results to be presented at a May, 2003 public meeting.

Consequences:
Several templates have been incorporated into planning documents of one municipality in Kane County (e.g., West Aurora Plan). Kane County expects to use project results in development of 2030 comprehensive land use plan. Project evaluation results will be used by Kane County to help municipalities develop stormwater management plans.

Stimulating development of similar projects in the Cuyahoga River Basin of Ohio and the Milwaukee River Basin of Wisconsin.

References:
Final reports expected by September, 2003.